Activation of VOHPO4 · 0.5H2O in propane/air mixture: effect on structural, morphological, oxidant's behaviour and catalytic property of (VO)2P2O7 catalysts for propane oxidation

Abstract

VOHPO4 • 0.5H2O synthesized by VOPO4 • 2H2O and isobutanol was activated in a flow of propane/air mixture (1% propane in air) at 673 K for 36, 75 and 132 h. Three vanadyl pyrophosphate catalysts obtained were denoted as VPD36P, VPD75P and VPD132P. The crystallinity of all propane/air pretreated catalysts as shown in XRD increased with the duration of calcination. SEM micrographs showed the formation of more isolated platelets and more prominent rosebud-shape agglomerate as the pre-treatment was longer. Four reduction peaks maxima at 752, 920, 1026 and 1140 were observed in the rate of hydrogen consumption for VPD36P. As the calcination duration increased to 75 h, the H2 reduction peaks were shifted to lower temperatures at 750, 882, 1004 and 1140 K. When the calcination duration was further increased to 132 h, only three reduction peaks were observed at 752, 952 and 1142 K. Despite the progressively shifted of the major reduction peak maximum as the duration of calcination increased from 36 to 132 h, the lattice oxygen from VPD36P was found to be the most reactive. The catalytic performance for propane oxidation to acrylic acid (AA) showed that VPD36P gave the highest activity (9.6%) with 83.0% of selectivity to AA.

Keyword: Acrylic acid; Propane oxidation; Vanadyl pyrophosphate